FEMI 209:080010

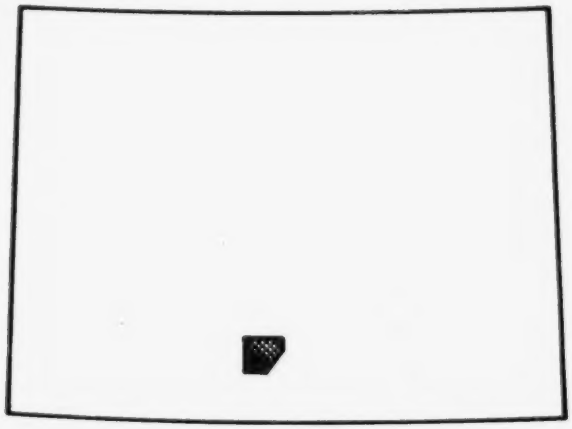
FLOOD INSURANCE STUDY

ORIGINAL

COMPLETED

34

CITY OF ALAMOSA, COLORADO
ALAMOSA COUNTY



SEPTEMBER 1977
REVISED: 11/9/82

Federal Emergency Management Agency

COMMUNITY NUMBER - 080010

BEST DOCUMENT AVAILABLE

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	
	1.1 Purpose of Study	1
	1.2 Coordination	1
	1.3 Authority and Acknowledgments	1
2.0	AREA STUDIED	
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	5
	2.4 Flood Protection Measures	5
3.0	ENGINEERING METHODS	8
	3.1 Hydrologic Analyses	8
	3.2 Hydraulic Analyses	8
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	10
	4.1 Flood Boundaries	10
	4.2 Floodways	11
5.0	INSURANCE APPLICATION	13
	5.1 Reach Determinations	13
	5.2 Flood Hazard Factors	14
	5.3 Flood Insurance Zones	14
	5.4 Flood Insurance Rate Map Description	15
6.0	OTHER STUDIES	15

BEST DOCUMENT AVAILABLE

TABLE OF CONTENTS - continued

	Page
7.0 LOCATION OF DATA	15
8.0 BIBLIOGRAPHY AND REFERENCES	17

FIGURES

Figure 1 - Vicinity Map	3
Figure 2 - Flooding at State Avenue, Alamosa, Colorado, on October 8, 1911	6
Figure 3 - Flooding at 4th and Hunt Avenues, Alamosa, Colorado, on October 8, 1911	6
Figure 4 - Flooding in Alamosa, Colorado, on October 8, 1911	7
Figure 5 - Flooding on the Rio Grande Near the Railroad Bridge at Alamosa, Colorado, on October 8, 1911	7
Figure 6 - Frequency-Discharge, Drainage Area Curves	9
Figure 7 - Floodway Schematic	13

TABLES

Table 1 - Floodway Data	12
Table 2 - Flood Insurance Zone Data	16

EXHIBITS

Flood Profiles	
Rio Grande	Panels 01P-03P
Rio Grande-Left Overbank	Panel 04P
Rio Grande-Right Overbank	Panel 05P
Flood Boundary Floodway Map Index	
Flood Boundary Bloodway Map	Panels 080010 0001-0002 B

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index	
Flood Insurance Rate Map	Panels 080010 0001-0002B

REVISED: 11/9/82

BEST DOCUMENT AVAILABLE

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Alamosa, Alamosa County, Colorado, and to aid in the administration of the Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Alamosa to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The purpose and objectives of the Flood Insurance Program and this study were explained in a public meeting with city officials on December 18, 1974. Additional coordination was accomplished by telephone and written correspondence. Meetings were held with city officials on July 15 and 30, 1975 to explain the results of the study. The floodway proposed at this meeting was not acceptable and the city requested further study. Another meeting was held on August 13, 1975, during which the floodway concept was explained in detail and various alternate proposed floodways were left with local officials to study. On December 23, 1975, local officials accepted the floodway designated in proposal number five.

The final community coordination meeting was held on July 15, 1976. The Federal Insurance Administration Acting Regional Director and officials from the city and Alamosa County attended the meeting. The only opposition to the study expressed at this meeting was directed at the mandatory insurance aspects of the program.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers, Albuquerque District, for the Federal Insurance Administration, under Inter-Agency Agreement Nos. IAA-H-16-75 and IAA-H-7-76, Project Order Nos. 19 and 1, respectively. This work, which was completed in January 1976, covered all flooding sources affecting the City of Alamosa, Alamosa County, Colorado.

BEST DOCUMENT AVAILABLE

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Alamosa, located in the center of Alamosa County, in south-central Colorado. The area of study is shown on the Vicinity Map (Figure 1). The Rio Grande, flowing from the northwest to the southeast, forms the northern city limits of Alamosa.

To identify the flood hazard areas in Alamosa, a detailed study was made of the Rio Grande and its flood plains within and adjacent to the City of Alamosa. Consideration was given to all known future development and proposed construction through January 1982.

2.2 Community Description

Alamosa, the county seat of Alamosa County, is located in the heart of the San Luis Valley and is the crossroad of south-central Colorado. Denver is approximately 219 miles to the north of Alamosa, whereas Santa Fe, New Mexico, is directly south, located approximately 150 miles away from the city.

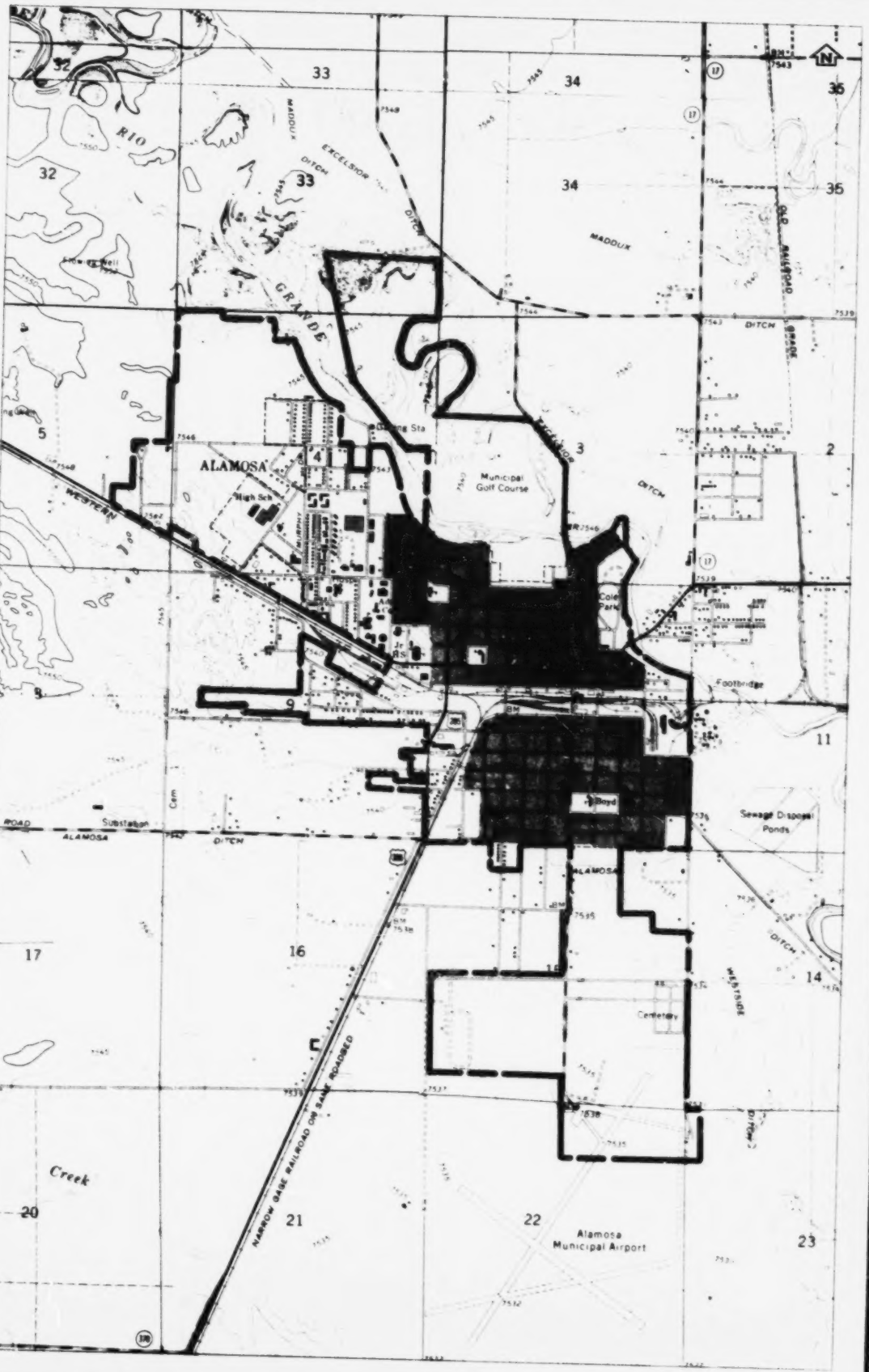
Alamosa was founded on July 4, 1878, the date the Denver and Rio Grande Western Railroad completed its rail connection from Denver to the community's site on the banks of the Rio Grande. Cottonwood trees lined the river, and consequently the townsite was named Alamosa, which means "cottonwood trees" in Spanish.

Development of the region was closely linked with the expanding Rio Grande railroad system. The original line was completed over the Sangre de Cristo Mountains to Russell in 1877 and reached Alamosa in July 1878. Surveys were extended in all directions from Alamosa in order to tap the rich mineral resources of the region. The next 2 or 3 years saw many of these surveys translated into ever-increasing miles of track. The rapid development, first of the mining industry, and then of agriculture in its various phases, made the rail extensions economically feasible. By 1890, the San Luis Valley was covered by railways, with Alamosa at the hub.

In 1913, the Colorado legislature carved a new county out of the northern portions of Conejos and Castilla Counties and called it Alamosa County. The City of Alamosa was designated as county seat of the new county.

The City of Alamosa grew and developed into what is now the trading center of the San Luis Valley. Several thousand freight cars of vegetables and stock leave the San Luis Valley each year.

BEST DOCUMENT AVAILABLE



APPROXIMATE SCALE
0 3400 6800 10200 FEET

VICINITY MAP

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ALAMOSA, CO
(ALAMOSA CO.)

REVISED: 11/9/82

FIGURE 1

BEST DOCUMENT AVAILABLE

The population of Alamosa in 1910 was 3013; in 1970, the U.S. Bureau of Census reported a population of 6698. The city government consists of a mayor and an eight-member council.

In the study area, the average temperature is 64.6°F in July and 16.6°F in January. The annual mean temperature is 41.9°F. Average precipitation, including winter snows and summer showers, has been approximately 5.5 inches. The maximum 24-hour precipitation recorded at Alamosa is 1.78 inches. During the winter months, there is heavy snowfall in the upper mountainous area of the Rio Grande Watershed. The average annual snowfall at Alamosa is 22.8 inches.

The Rio Grande, one of the principal streams in the southwestern United States, is an interstate and international river. From its source on the eastern slopes of the Rocky Mountains in south-central Colorado, the Rio Grande flows eastward for approximately 150 miles to Alamosa and then southward to the Colorado-New Mexico state line. It flows through New Mexico to El Paso, Texas, where it becomes the international boundary between the United States and Mexico. The river originates along the Continental Divide in the San Juan Mountain Range at elevations generally above 10,000 feet National Geodetic Vertical Datum of 1929 (NGVD). Along the Continental Divide, the river is fed by perpetual snowfields and springs. Between its source and the Alamosa stream gage, the river drains approximately 1710 square miles. The Rio Grande meanders through the San Luis Valley, a gently sloped plain surrounded by high mountain ranges. The San Luis Valley is approximately 100 miles long and approximately 60 miles wide. The valley is surrounded by the Sangre de Cristo Mountains on the east, the San Juan Mountains on the west, and the La Garita Mountains on the north. The Rio Grande is a perennial river, with streambed elevations ranging from 7538 feet NGVD at the upper end of the study reach to 7525 feet NGVD at the lower end.

The natural vegetation contains only a limited number of dominant species. The open pinon and juniper stands of the surrounding foothills give way to a sagebrush association around the well-drained margins of the region. On large portions of the valley floor, the greasewood association, dominated by the black greasewood and rabbit bush, is found. The groves of trees that line the stream courses are dominated by cottonwoods and willows.

The flood plains in Alamosa abound with commercial and residential developments, public facilities, and utilities. Transportation facilities crossing the flood plains include the famous Navajo Trail (U.S. Highway 160), the Trans-American Highway (U.S. Highway 285), numerous city streets, and the Denver and Rio Grande Western Railroad. New developments, which are primarily residential, are being located in the northwestern section of Alamosa.

BEST DOCUMENT AVAILABLE

2.3 Principal Flood Problems

The Rio Grande Basin in Colorado, because of its relatively high elevation and sheltered position, is less subject to destructive floods than any other major basin in Colorado. The earliest flood, that of 1869, is mentioned in newspaper accounts of considerably later date and little is known about it except that some damage did occur in Alamosa. A flood in 1884 was caused by the melting of a very heavy snow cover, augmented by heavy rains. This flood lasted longer than any other known flood (Reference 1). The Rio Grande was out of banks at Del Norte from about May 24 to June 20. The flood peaked on June 14 and 15, and was probably the greatest known flood in the San Luis Valley. The flood of 1905 was the only destructive flood in which rainfall was not a factor. This flood was caused by snowmelt. The flood of 1911 was the only one recorded in the upper Rio Grande Basin that was caused wholly by heavy rains. The flood of 1927 was the highest since stream gage records have been kept. This flood was caused by melting snow and increased by precipitation.

Scenes of the 1911 flood at Alamosa are shown in Figures 2 through 5.

Natural obstructions to floodflows along the Rio Grande include trees, brush, and other vegetation growing in and near the stream channel and between the levees. The meanders of the stream further reduce the flow efficiency. Manmade obstructions include landfills along the levee, two road bridges, and a railroad bridge. Additionally, two diversion channels and their associated embankments are obstructive to floodflows.

Flooding is also caused in some areas by street and runway drainage, an increased water table, direct rainfall, and drainage from other zones via rivulets.

Floods of approximately the 25-year or greater magnitudes will outflank the upper end of a levee system built along the Rio Grande in the area of the city, and become entrapped in the overbank areas.

2.4 Flood Protection Measures

No flood control structures exist on the Rio Grande above Alamosa to protect the study area. Local interests have constructed a levee system along the Rio Grande to protect Alamosa. The levee system begins just north of Alamosa and continues to the south of the community. Floods of about 25-year or greater magnitude will outflank the upper end of the levees and become entrapped in the overbank areas.

BEST DOCUMENT AVAILABLE

Figure 2. Flooding at State Avenue, Alamosa, Colorado, on October 8, 1911

Figure 3. Flooding at 4th and Hunt Avenues, Alamosa, Colorado, on October 8, 1911

BEST DOCUMENT AVAILABLE

Figure 4. Flooding in Alamosa, Colorado, on October 8, 1911

Figure 5. Flooding on the Rio Grande Near the Railroad Bridge at Alamosa, Colorado, on October 8, 1911

BEST DOCUMENT AVAILABLE

3.0 ENGINEERING METHODS

For flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10, 50, 100, and 500 years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the streams.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the segment of the Rio Grande studied in detail.

Floodflow frequency data for the Rio Grande was based on statistical analysis of stage-discharge records from the Del Norte gage, located approximately 30 miles upstream from Alamosa, and the Alamosa gage located in the City of Alamosa. The periods of record used were 83 years for the Del Norte gage and 60 years for the Alamosa gage (Reference 2). This analysis followed the standard log-Pearson Type III method, as outlined by the Water Resources Council (Reference 3).

The discharge for the 500-year flood was determined by straight-line extrapolation of a single-log graph of flood discharges computed for frequencies up to 100-years.

Frequency-Discharge, Drainage Area Curves for the Rio Grande are shown in Figure 6.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the Rio Grande were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the stream segment studied in detail.

Because sheet flooding water-surface elevations in the overbank areas of Alamosa are different from the water-surface elevations on the Rio Grande, individual water-surface profiles were developed using the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 4) for the Rio Grande and the left and right overbank flows. Digitized cross sections were developed by photogrammetric methods in a previous study (Reference 5), and were modified, repeated, or adjusted for bridges, diversions, and other general features in order to compute the significant backwater effects of all structures and features. For cross section locations, refer to the Flood Boundary Floodway Map.

For the overbank flows, profile stationing follows a right and left overbank base line, which is shown on the maps.

BEST DOCUMENT AVAILABLE

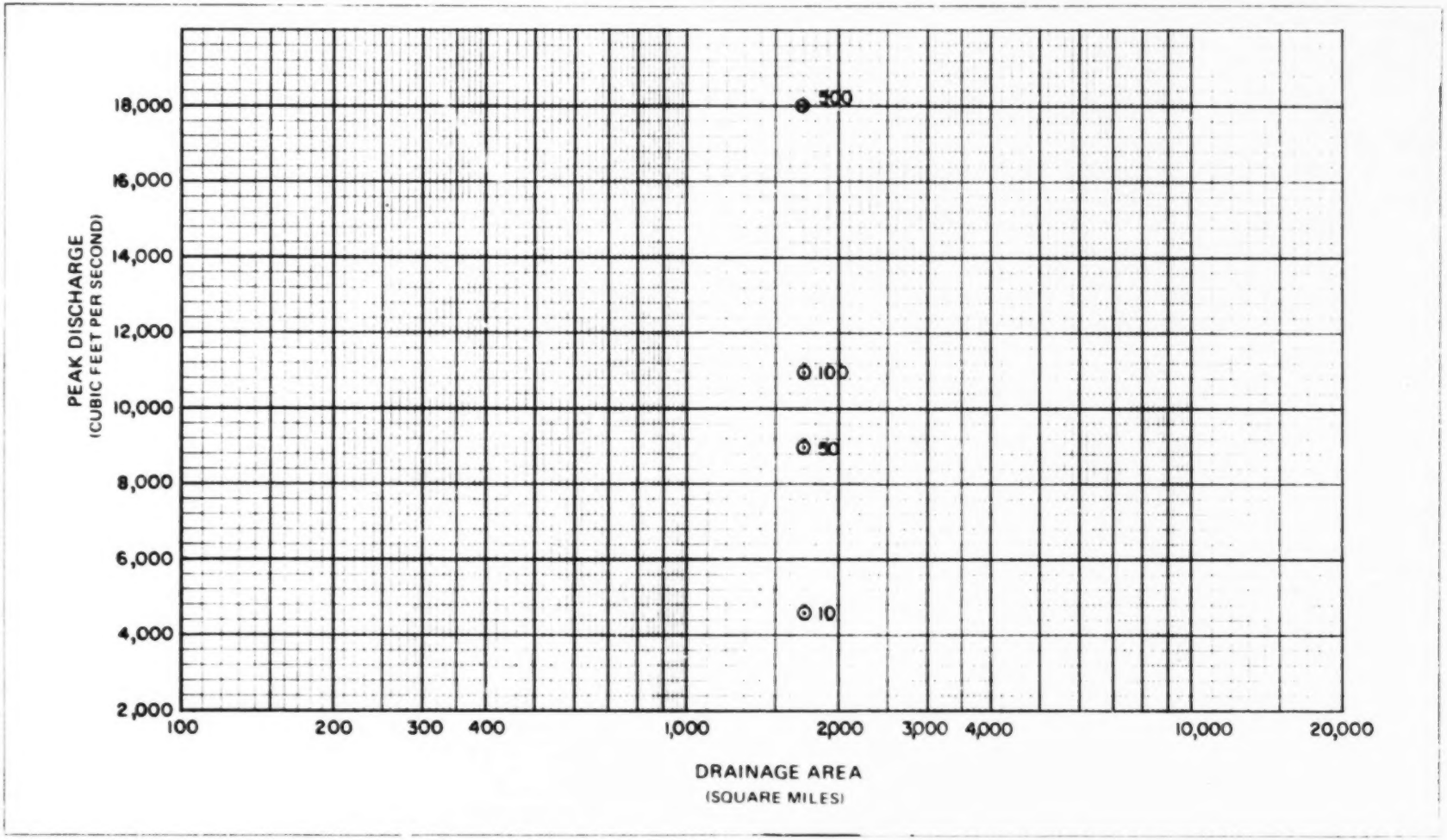


FIGURE 6

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF ALAMOSA, CO
(ALAMOSA CO.)

FREQUENCY-DISCHARGE, DRAINAGE AREA CURVES

RIO GRANDE

BEST DOCUMENT AVAILABLE

Channel and overbank roughness factors (Manning's "n") were assigned on the basis of field inspections and aerial photography. Roughness values vary from 0.035 to 0.040 for the channel, and from 0.070 to 0.110 for the overbanks.

Flood Profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Starting elevations were developed by the slope-area method. All elevations are referenced to the National Geodetic Vertical Datum. Elevation reference marks used in this study are shown on the maps.

For study purposes herein, it has been assumed that limited clogging of the main river channel will occur, and the levee and all bridges will remain intact.

4. FLOOD PLAIN MANAGEMENT APPLICATION

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Emergency Management Agency as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each watercourse studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were determined using topographic maps at a scale of 1:4800, with contour intervals of 2 feet (Reference 5). In cases where the 100-year and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The absence of well-defined watercourses in the overbank areas of the Rio Grande makes flood paths unpredictable. Because of this unpredictability, most of Alamosa is designated as a sheet flow area.

Numerous small areas within the flood boundaries may be above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

BEST DOCUMENT AVAILABLE

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Emergency Management Agency limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as a minimum standard that can be adopted or that can be used as a basis for additional studies.

The floodway for the Rio Grande at Alamosa was computed for maximum use of the existing levee system. Floodway adjustments were made in the reach below cross section C for manmade obstructions in the flood plain. From cross section C to cross section O, the right overbank levee was assumed as the right bank floodway limit. The left bank floodway limit was adjusted to use the left overbank levee as the floodway limit. Therefore, the left overbank levee is, with few exceptions, the left floodway limit. Above cross section O, the right bank floodway limit was assumed in accordance with the city's development plans; the left overbank curvilinear flood plain, without restrictions, is the left floodway limit.

The results of the floodway computations are tabulated at selected cross sections for the Rio Grande (Table 1). As shown on the Flood Boundary Floodway Map, the floodway boundaries were determined at cross sections; between cross sections, the boundaries were determined photogrammetrically. In cases where the 100-year flood and the floodway boundaries are close together, only the floodway boundaries have been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 7.

REVISED: 11/9/82

FLOODING SOURCE [1]		FLOODWAY [1]			BASE FLOOD WATER SURFACE ELEVATION [1]		
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE
RIO GRANDE							
E	12,830[2]	790[3]	4,527	2.4	7537.7	7537.3	0.4
F	13,650[2]	413[3]	2,672	4.1	7537.9	7537.5	0.4
G	14,530[2]	472[3]	2,809	3.9	7538.8	7538.0	0.8
H	15,330[2]	275[3]	1,643	6.7	7539.3	7538.5	0.8
I	16,720[2]	650[3]	4,208	2.6	7541.2	7540.2	1.0
J	18,090[2]	558[3]	4,198	2.6	7541.9	7540.9	1.0
K	19,280[2]	470[3]	3,353	3.3	7542.4	7541.4	1.0
L	21,080[2]	620[3]	4,091	2.7	4543.1	7542.1	1.0
M	22,830[2]	540[3]	3,041	3.7	7543.6	7542.6	1.0
N	24,840[2]	611[3]	4,104	2.7	7544.6	7543.6	1.0

[1]Data Applies Only to Rio Grande Channel
[2]Distance in Feet Above River Mile 45.53 (45.53 Miles Above Colorado State Line)
[3]All or Part of Floodway Outside Corporate Limits

REVISED: 11/9/82

TABLE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ALAMOSA, CO
(ALAMOSA CO.)

FLOODWAY DATA

RIO GRANDE

BEST DOCUMENT AVAILABLE

BEST DOCUMENT AVAILABLE

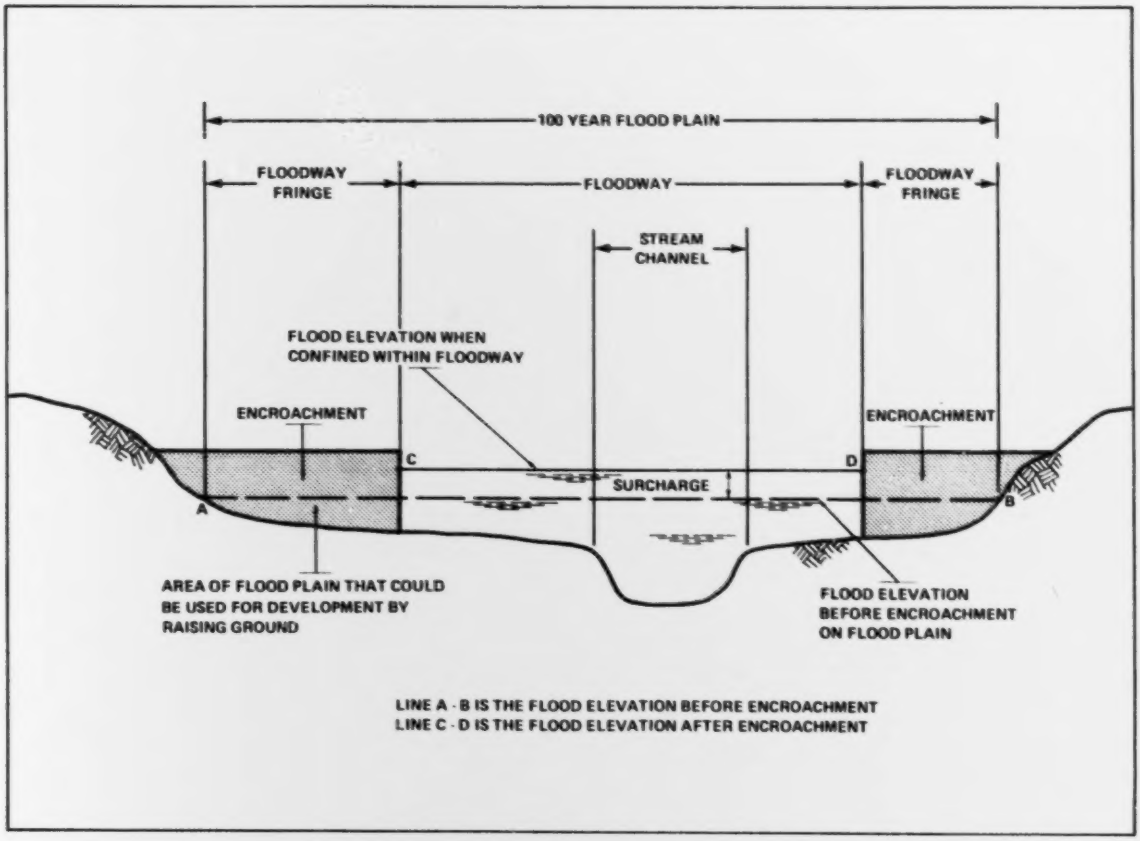


Figure 7. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Emergency Management Agency has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for the Rio Grande at Alamosa.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

BEST DOCUMENT AVAILABLE

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot

One reach meeting the above criterion was required for the Rio Grande in Alamosa. The location of the reach is shown on the Flood Profiles.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Emergency Management Agency device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire incorporated area of the City of Alamosa was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A0:	Special flood hazard areas inundated by types of shallow flooding where depths are between 1.0 and 3.0 feet and the product of the depth (in feet) and velocity (in feet per second) is less than 15; no Flood Hazard Factors determined.
Zone A4:	Special flood hazard areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.

BEST DOCUMENT AVAILABLE

Zone B:	Areas between the special flood hazard areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 2, "Flood Insurance Zone Data," summarizes the flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Alamosa is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Emergency Management Agency.

6.0 OTHER STUDIES

Preliminary work, including aerial photography, land survey, and hydrology, for this study was developed in preparation of a Flood Plain Information Report for Alamosa County and vicinity. The Flood Plain Information Report was discontinued in favor of a Flood Insurance Study for Alamosa County and this study for the city. The study for the county (Reference 6) is in progress and has not yet been published.

The present study is authoritative for purposes of the Flood Insurance Program, and presented information either supersedes or is compatible with all previous studies.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study are on file through 1981 with the Director, Insurance & Mitigation Division, Federal Emergency Management Agency, Denver Federal Center, Building 710, Lakewood, CO 80225.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
RIO GRANDE Reach 1	01	-1.91	-0.51	+1.18	020	A4	Varies - See Map
LEFT OVERBANK Sheet Flow	01	Data	Not Applicable			A0	Varies - See Map
RIGHT OVERBANK Sheet Flow	01, 02	Data	Not Applicable			A0	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ALAMOSA, CO
(ALAMOSA CO.)

FLOOD INSURANCE ZONE DATA

RIO GRANDE-LEFT OVERBANK-RIGHT OVERBANK

BEST DOCUMENT AVAILABLE

BEST DOCUMENT AVAILABLE

8.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Geological Survey, Water Supply Paper No. 997, Floods in Colorado, 1948

2. ----------, Surface Water Records, Water Resources Data for Colorado, Part 1, Annual Publication

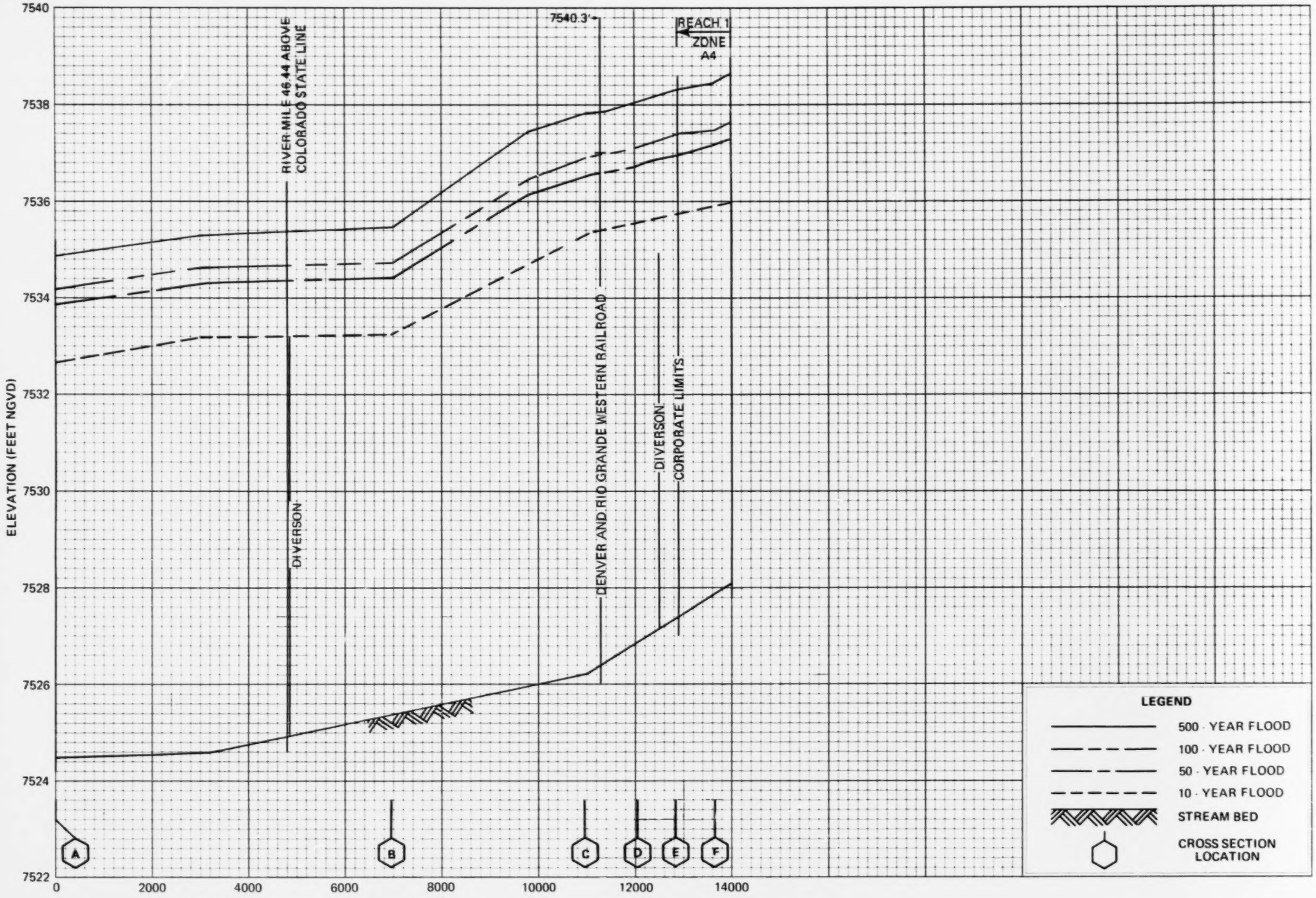
3. Water Resource Council, "A Uniform Technique for Determining Flood Flow Frequencies," Bulletin 15, December 1967

4. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, September 1971, Updated June 1974

5. Nelson, Haley, Patterson, and Quirk, Aerial Survey, Alamosa and Alamosa County, Colorado, Scale 1:4,800, Contour Interval 2 feet: Alamosa and Alamosa County, Colorado (May 1974)

6. U.S. Army Corps of Engineers, Albuquerque District, Flood Insurance Study, Alamosa County, Colorado, unpublished

BEST DOCUMENT AVAILABLE



FLOOD PROFILES

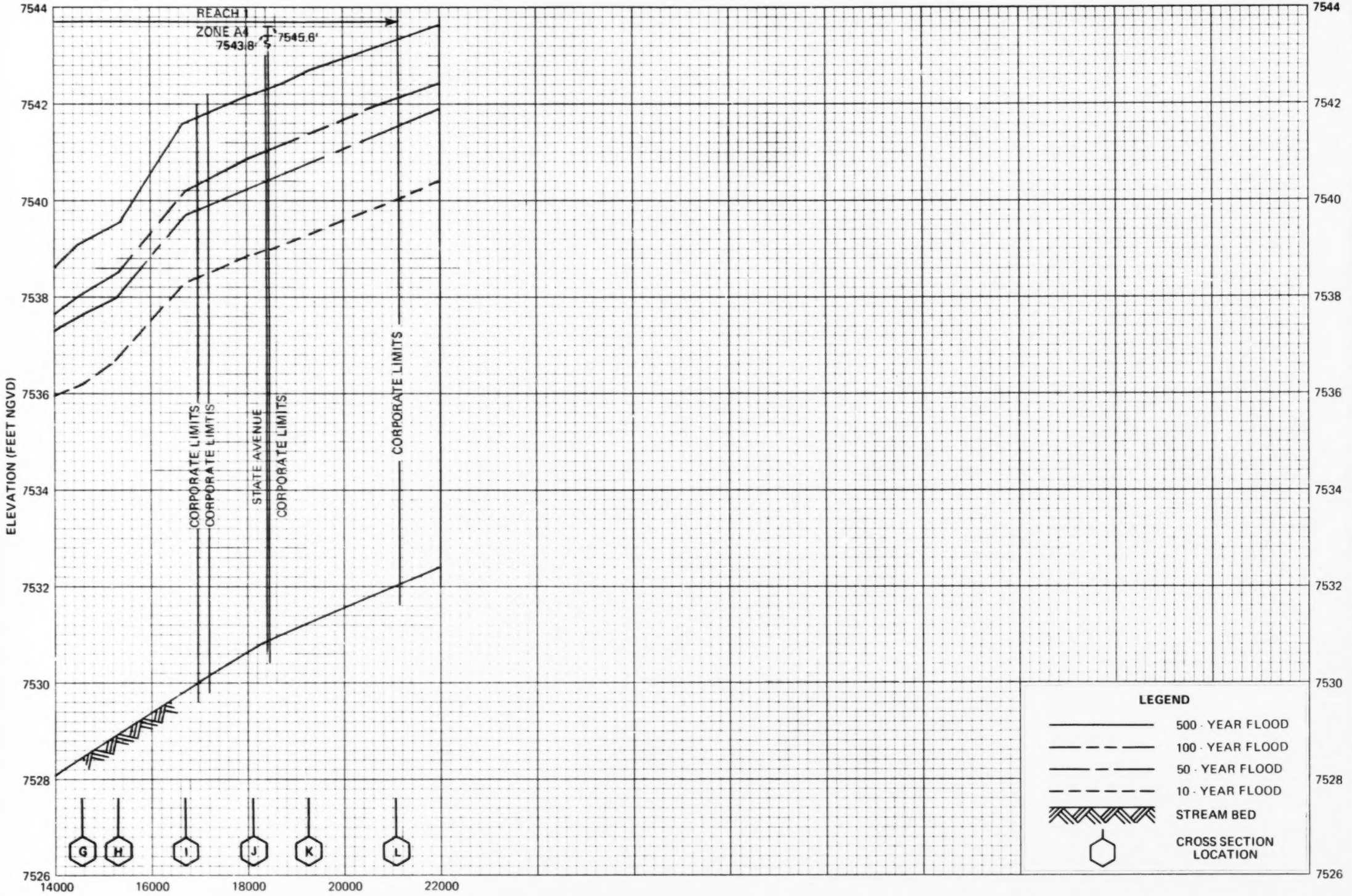
RIO GRANDE

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF ALAMOSA, CO
(ALAMOSA CO.)

01P

BEST DOCUMENT AVAILABLE



CHANNEL DISTANCE IN FEET ABOVE RIVER MILE 45.53 (45.53 MILES ABOVE THE COLORADO STATE LINE)

FLOOD PROFILES

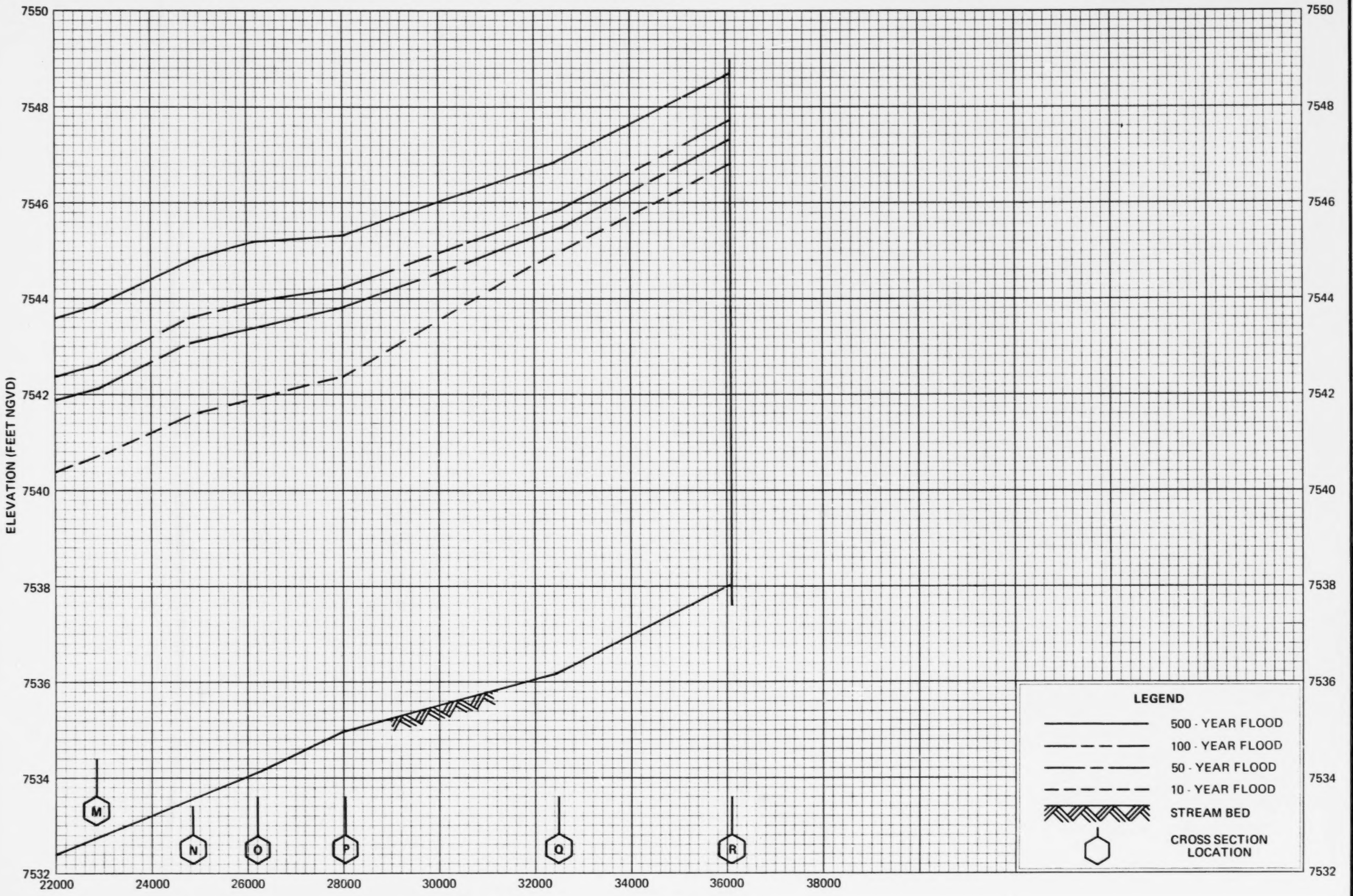
RIO GRANDE

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF ALAMOSA, CO
(ALAMOSA CO.)

02P

BEST DOCUMENT AVAILABLE



CHANNEL DISTANCE IN FEET ABOVE RIVER MILE 45.53 (45.53 MILES ABOVE THE COLORADO STATE LINE)

FLOOD PROFILES

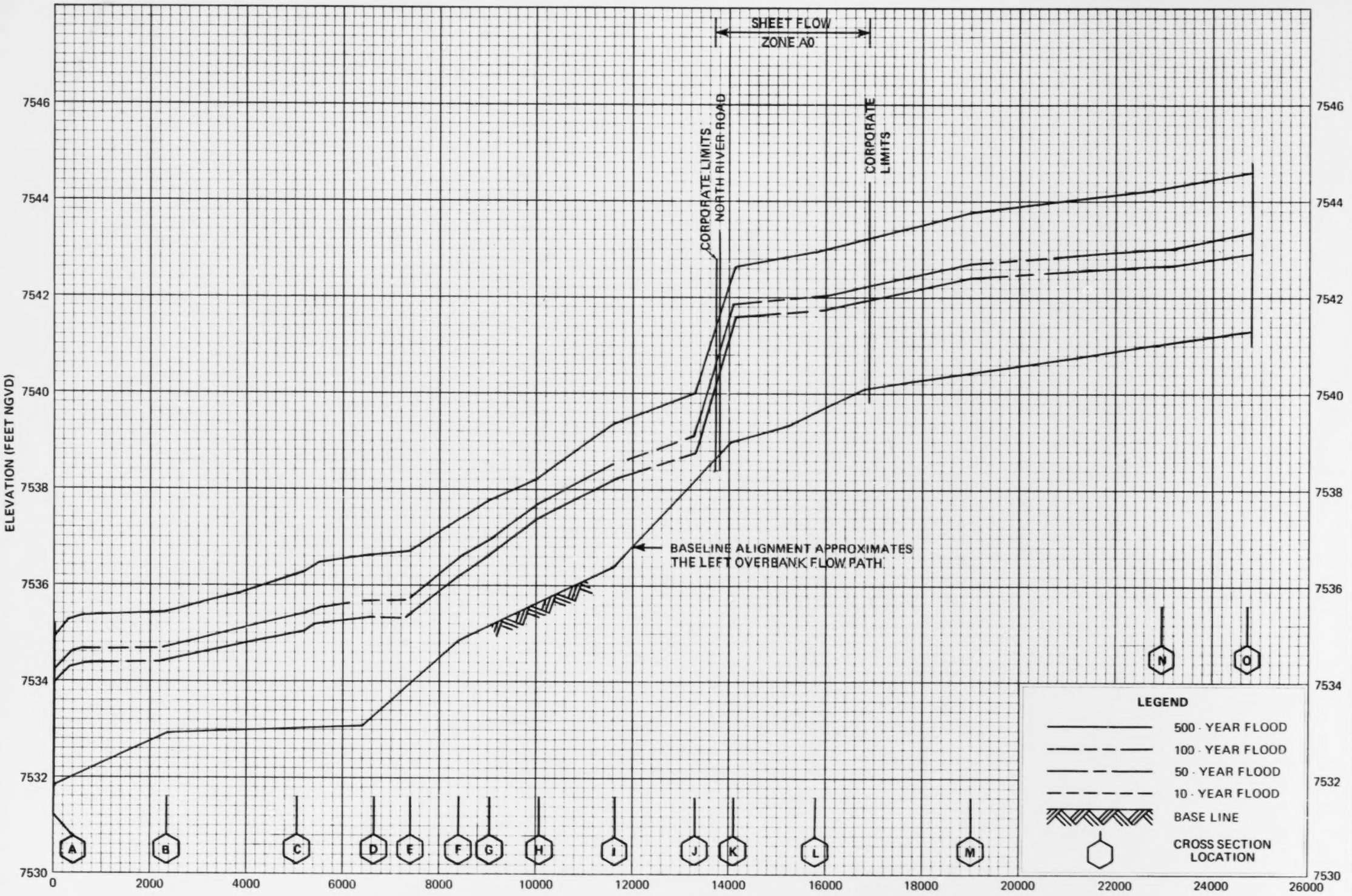
RIO GRANDE

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF ALAMOSA, CO
(ALAMOSA CO.)

03P

BEST DOCUMENT AVAILABLE



BASELINE DISTANCE IN FEET ABOVE RIVER MILE 45.53 (45.53 MILES ABOVE THE COLORADO STATE LINE)

FLOOD PROFILES

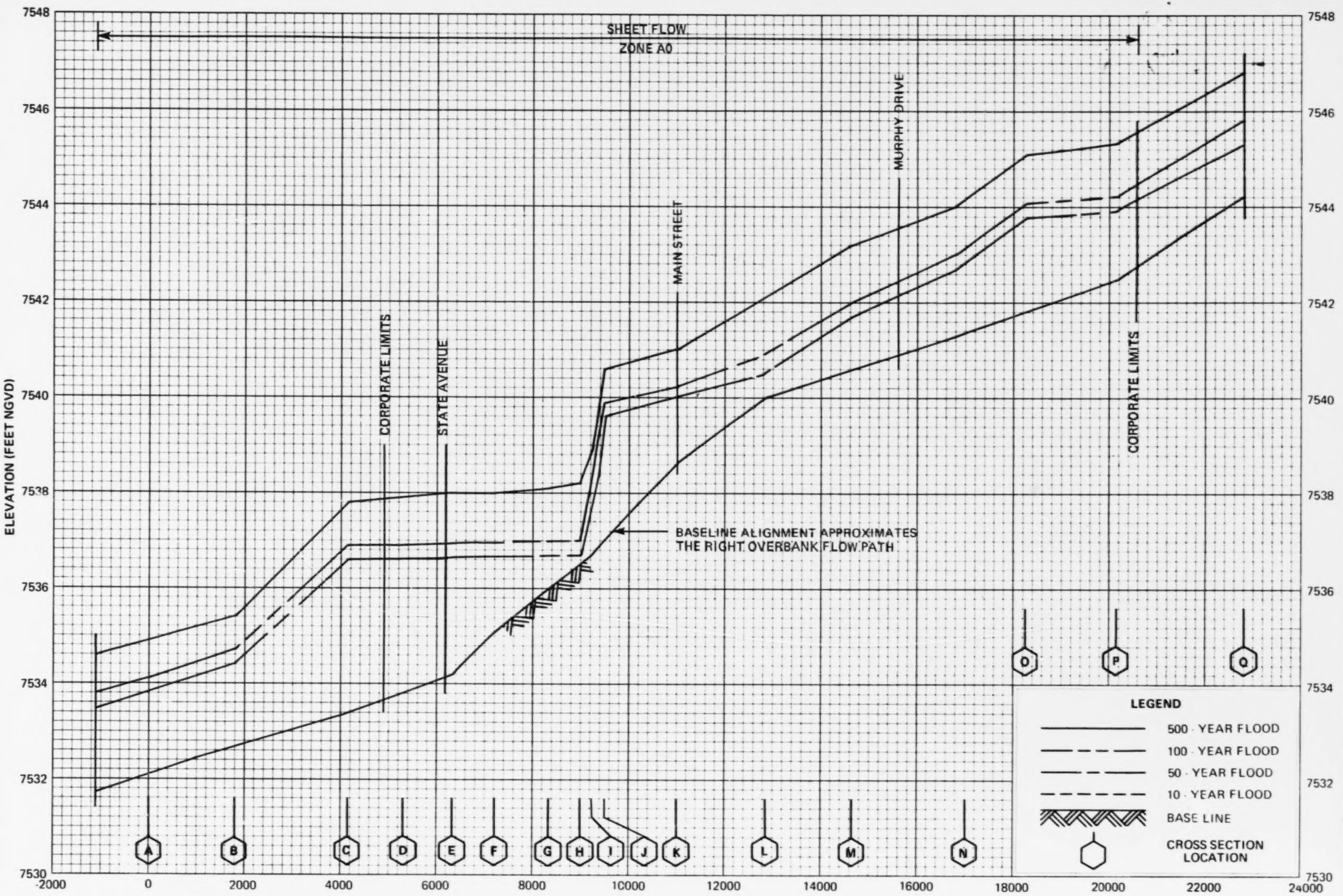
RIO GRANDE - LEFT OVERBANK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF ALAMOSA, CO
(ALAMOSA CO.)

04P

BEST DOCUMENT AVAILABLE



BASELINE DISTANCE IN FEET FROM RIVER MILE 45.53 (45.53 MILES ABOVE THE COLORADO STATE LINE)

FLOOD PROFILES

RIO GRANDE - RIGHT OVERBANK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF ALAMOSA, CO
(ALAMOSA CO.)

05P